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Nanovoids in glasses and polymers probed by positron annihilation lifetime spectroscopy

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Abstract

Nanovoids in As2S3-based glasses (As 2S3, (As2S3)85Ag 15, and (As2S3)85(AgI) 15), a polymer and a As2S3-polymer nanocomposite were studied using the positron annihilation lifetime spectroscopy (PALS) technique. After computer treatment of the PALS data recorded, it was found that only two components τ 1 (short-lived) near 0.2 ns and τ 2 (long-lived) near 0.4 ns are resolved for the As 2S3-based glasses. At the same time, in the case of the polymer sample two components τ 2 near 0.3 ns and τ 3 (pick-off annihilation of ortho-positronium) near 2.8 ns were detected, while for the As2S3-polymer nanocomposite three components τ 1 near 0.2-0.3 ns, τ 2 near 0.4-0.5 ns and τ 3 near 2.4 ns were established. The volume of nanovoids in the materials studied was determined, and the fractional free volumes of the As2S3-polymer nanocomposite and the polymer matrix were compared. The results obtained are important to utilize As2S 3-based glasses and polymer nanocomposites for advanced sensor applications. © 2011 Springer Science+Business Media B.V.

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Keywords

Chalcogenide glasses, Nanovoids, Polymers, Positron annihilation lifetime spectroscopy